

Study Guide

Textbook: Sadava et al.: **Life. The Science of Biology, 9. Ed. Vol. I The Cell and Heredity.**

NB! The comments are meant to help distinguish between relevant and less relevant material. Nevertheless, exam questions concerning all material in the chapter can be asked.

KEY CONCEPTS

1. The cell is the basic unit of life. All cells come from preexisting cells and have certain processes, types of molecules, and structures in common.
2. Cells may have originated from “protocells”— cell-like structures thought to be similar to structures that can be produced in the laboratory.
3. To maintain adequate exchanges with its environment, a cell’s surface area must be large compared with its volume.
4. Microscopes are needed to visualize cells. Because of their greater resolving power, electron microscopes allow observation of greater detail than can be seen with light microscopes, while light microscopes provide a window into living cells.
5. Prokaryotic cell organization is characteristic of the domains Bacteria and Archaea. Prokaryotic cells lack membrane-bound internal compartments. The lack of a nucleus has given prokaryotes their name: pro = before, karyon = nut/kernel ~ nucleus.
6. Prokaryotic cells each contain a nucleoid region, ribosomes and cytoplasm. Many also have cell walls, internal membranes, flagella, pili, and/or a cytoskeleton.
7. Eukaryotic cells (cells in the domain Eukarya) have many different membrane-enclosed organelles. Eu = true/real, karyon = nut/kernel ~ nucleus.
8. Organelles can be studied by microscopy or isolated by cell fractionation.
9. The nucleus, which is usually the largest organelle in a cell, contains most of the cell’s DNA and communicates with the cytosol via nuclear pores.

10. The rough endoplasmic reticulum has attached ribosomes that synthesize proteins. The smooth endoplasmic reticulum lacks ribosomes and participates in the synthesis of lipids.
11. The Golgi apparatus packages proteins inside vesicles and directs their transport.
12. Lysosomes contain digestive enzymes.
13. Mitochondria are enclosed by an outer membrane and an inner membrane that folds inward to form cristae. Mitochondria contain the proteins needed for cellular respiration and the generation of ATP.
14. Chloroplasts are enclosed by two membranes and contain an internal system of thylakoids organized as grana. Chloroplasts carry out photosynthesis. Only plant cells and certain protists (unicellular eukaryotes) contain chloroplasts.
15. Peroxisomes and glyoxysomes contain specialized enzymes that carry out chemical reactions involved in the detoxification of damaging peroxide compounds.
16. Vacuoles are prominent in many plant cells and consist of a membrane-enclosed compartment that contains water and dissolved substances. By taking in water, vacuoles enlarge and provide the pressure needed to stretch the cell wall and provide structural support for the plant.
17. The cytoskeleton within the cytoplasm of eukaryotic cells provides shape, strength, and movement. It consists of three interacting types of protein fibers: microfilaments, which organize cell shape and facilitate movements, intermediate filaments, which provide strength and cell attachments, and microtubules, which are involved in cell organization (via the centrioles), intracellular transport, and movements of cilia and flagella.
18. The cell wall of plants consists principally of cellulose. It is pierced by plasmodesmata that join the cytoplasm of adjacent cells.
19. In multicellular animals, the extracellular matrix incorporates three different kinds of macromolecules including fibrous collagen, glycoproteins (including proteoglycans), and linkage proteins.
20. The endosymbiosis theory proposes that mitochondria and chloroplasts originated when large prokaryotes engulfed, but did not digest, smaller prokaryotes. The endosymbiotic theory is supported by genetic analyses and by recent observations of a single-cell eukaryote engulfing and preserving a species of green algae.

KEY TERMS

Cell theory: States that cells are the basic structural and physiological units of all living organisms, and that all cells come from preexisting cells.

Cell wall: A relatively rigid structure that encloses cells of plants, fungi, many protists, and most prokaryotes, and which gives these cells their shape and limits their expansion in hypotonic media.

Chloroplast [Gk. kloros: green + plast: a particle]: An organelle bounded by a double membrane containing the enzymes and pigments that perform photosynthesis. Chloroplasts occur only in eukaryotes.

Cilium (sil' ee um) (plural: cilia) [L. eyelash]: Hairlike organelle used for locomotion by many unicellular organisms and for moving water and mucus by many multicellular organisms. Generally shorter than a flagellum.

Collagen [Gk. kolla: glue]: A fibrous protein found extensively in bone and connective tissue.

Cytoplasm: The contents of the cell, excluding the nucleus.

Cytoskeleton: The network of microtubules and microfilaments that gives a eukaryotic cell its shape and its capacity to arrange its organelles and to move.

Cytosol: The fluid portion of the cytoplasm, excluding organelles and other solids.

Endomembrane system: A system of intracellular membranes that exchange material with one another, consisting of the Golgi apparatus, endoplasmic reticulum, and lysosomes when present.

Endoplasmic reticulum (ER) [Gk. endo: within + L. reticulum: net]: A system of membranous tubes and flattened sacs found in the cytoplasm of eukaryotes. Exists in two forms: rough ER, studded with ribosomes; and smooth ER, lacking ribosomes.

Endosymbiosis theory [Gk. endo: within + sym: together + bios: life]: The theory that the eukaryotic cell evolved via the engulfing of one prokaryotic cell by another.

Eukaryotes (Eukarya): Organisms made up of one or more complex cells in which the genetic material is contained in nuclei. (Contrast with archaeans and bacteria.)

Extracellular matrix: A material of heterogeneous composition surrounding cells and performing many functions including adhesion of cells.

Flagellum (fla jell' um) (plural: flagella) [L. flagellum: whip]: Long, whiplike appendage that propels cells. Prokaryotic flagella differ sharply from those found in eukaryotes.

Golgi apparatus (goal' jee): A system of concentrically folded membranes found in the cytoplasm of eukaryotic cells; functions in secretion from cell by exocytosis.

Lysosome: Membrane-enclosed organelle in which material taken into the cell by phagocytosis is hydrolysed.

Microfilament: In eukaryotic cells, a fibrous structure made up of actin monomers. Microfilaments play roles in the cytoskeleton, in cell movement, and in muscle contraction.

Microtubules: Tubular structures found in centrioles, spindle apparatus, cilia, flagella, and cytoskeleton of eukaryotic cells. These tubules play roles in the motion and maintenance of shape of eukaryotic cells.

Mitochondrion (my' toe kon' dree un) (plural: mitochondria) [Gk. mitos: thread + chondros: grain]: An organelle in eukaryotic cells that contains the enzymes of the citric acid cycle, the respiratory chain, and oxidative phosphorylation.

Nucleoid (new' klee oid): The region that harbors the chromosomes of a prokaryotic cell. Unlike the eukaryotic nucleus, it is not bounded by a membrane.

Nucleolus (new klee' oh lus): A small, generally spherical body found within the nucleus of eukaryotic cells. The site of synthesis of ribosomal RNA.

Nucleus (new' klee us) [L. nux: kernel or nut]: The centrally located compartment of eukaryotic cells that is bounded by a double membrane and contains the chromosomes.

Organelle (or gan el'): Any of the membrane-enclosed structures within a eukaryotic cell. Examples include the nucleus, endoplasmic reticulum, and mitochondria.

Peroxisome: An organelle that houses reactions in which toxic peroxides are formed and then converted to water.

Plasma membrane: The membrane that surrounds the cell, regulating the entry and exit of molecules and ions. Every cell has a plasma membrane.

Plasmodesma (plural: plasmodesmata) [Gk. plassein: to mold + desmos: band]: A cytoplasmic strand connecting two adjacent plant cells.

"Prokaryotes": Not a monophyletic group; as commonly used, includes the bacteria and archaeans. A term of convenience encompassing all cellular organisms that are not eukaryotes.

Ribosome: A small particle in the cell that is the site of protein synthesis.

Rough endoplasmic reticulum (RER): The portion of the endoplasmic reticulum whose outer surface has attached ribosomes. (Contrast with smooth endoplasmic reticulum.)

Smooth endoplasmic reticulum (SER): Portion of the endoplasmic reticulum that lacks ribosomes and has a tubular appearance. (Contrast with rough endoplasmic reticulum.)

Thylakoid (thigh la koid) [Gk. thylakos: sack or pouch]: A flattened sac within a chloroplast. Thylakoid membranes contain all of the chlorophyll in a plant, in addition to the electron carriers of photophosphorylation. Thylakoids stack to form grana.

Vacuole (vac' yew ole): Membrane-enclosed organelle in plant cells that can function for storage, water concentration for turgor, or hydrolysis of stored macromolecules.